10th Class 2014

Physics	Group-I	
Time: 2:45 Hours	(SUBJECTIVE TYPE)	Marks: 63

Part-I

2. Write short answers to any Five (5) questions: 10

(i) With respect to simple pendulum, what is difference between vibration and amplitude?

Ans

Vibration	Amplitude
"One complete round trip of a vibrating body about its mean position is called one vibration."	"The maximum displacement of a vibrating body on either side from its mean position is called amplitude." **Unit:** The SI unit is metre (m).

(ii) What are audible frequency range for young children and old people?

Ans Young children can hear sounds of 20,000 Hz but old people cannot hear sounds even above 15,000 Hz.

(iii) Calculate the frequency of sound wave of speed 340 m/s and wavelength 0.5 m.

Ans

$\lambda = 0.5$ m

$v = 340\ ms^{-1}$

As we know,

$$v = f\lambda$$

$$f = \frac{v}{\lambda}$$

Now, put the values:

$$f = \frac{340}{0.5}$$

$$\boxed{f = 680\ Hz}$$

(iv) What is difference between musical sound and noise?

Ans **Musical Sounds**

"The sounds having pleasant effect on our ears are called musical sounds."

Examples:

Sounds of musical instruments such as flute, violin, drum, etc.

Noise

"The sounds which create jarring effect on our ears are called noise."

Examples:

Sound of traffic, sounds of machinery, etc.

(v) What is difference between regular and irregular reflection? State.

Ans **Regular reflection:**

Such a reflection in which rays of light reflect in one direction only is known as regular reflection.

Irregular reflection:

Such a reflection in which rays of light reflect in many directions is known as irregular reflection.

(vi) State laws of reflection.

Ans There are two laws of reflection of light:

1. The incident ray, the normal and reflected ray at point of incidence all lie in same plane.
2. The angle of incidence is equal to the angle of reflection.

$$\angle\hat{i} = \angle\hat{r}$$

(vii) Define refractive index. What is its unit?

Ans "The refractive index of a medium is ratio of speed of light in a vacuum to speed of light in the medium."

$$\text{Refractive index} = \frac{\text{Speed of light in vacuum}}{\text{Speed of light in medium}}$$

If refractive index is denoted by n, speed of light in vacuum by c and speed of light in medium by v, we get relation:

$$n = \frac{c}{v}$$

Units: It is ratio of two same quantities. So, it has no unit.

(viii) Define capacitance. State its SI unit.

Ans "Capacitance is ratio between charge and potential difference applied across plates of the capacitor."

Unit: SI unit of capacitance is farad (F).

Farad:

If one coulomb of charge given to plates of capacitor produces a potential difference of 1 V between plates of capacitor, its capacitance would be one "farad".

3. Write short answers to any Six (6) questions: 12

(i) Write the formula of parallel combination of capacitor.

Ans The formula of parallel combination of capacitor is:

$$C_{eq} = C_1 + C_2 + C_3 + ... + C_n$$

(ii) State Joule's law. Write down its formula.

Ans **Joule's law:**

The amount of energy generated in a resistance due to flow of charges is equal to product of square of current, resistance and time duration.

Formula:

$$W = I^2 R T$$

$$W = \frac{V^2 t}{R}$$

(iii) Define electric field intensity and write its unit.

Ans "The strength of electric field at any point in space is known as electric field intensity."

Its formula is:

$$E = \frac{F}{q_0}$$

Unit: So, its unit is NC^{-1}.

(iv) Define electromotive force.

Ans "It is the energy supplied by a battery to a unit charge when it flows through the closed circuit."

Unit: Its unit is volt.

(v) Define resistance and give the name of unit.

Ans "The property of substance which offers opposition to flow of current through it is called its resistance."

Unit: The SI unit of resistance is ohm (Ω).

(vi) Define potential difference and write the name of unit.

Ans "The work done between two points against electric forces to move a unit positive charge from one point to another in an electric field is called potential difference."

Unit: Its unit is volt.

(vii) If 0.5 C charge passes through a wire in 10 s then, what will be value of current flowing through the wire?

Ans **Given data:**

$Q = 0.5\ C$

$t = 10\ s$

To find:

$I = ?$

Solution:

$$Q = I\,t$$

$$I = \frac{Q}{t}$$

$$I = \frac{0.5}{10} = 0.05\ A$$

$$\boxed{I = 0.05\ A}$$

(viii) Define resistivity and write the formula.

Ans "The resistance of one metre cube of substance is equal to its specific resistance or resistivity."

It is denoted by 'ρ'.

Formula:

$$R = \rho \frac{L}{A}$$

$$\rho = \frac{RA}{L}$$

(ix) **Define Lenz's law.**

Ans **Lenz's law:**

The direction of an induced current in a circuit is always such that it opposes the cause that produces it.

4. Write short answers to any Five (5) questions: 10

(i) **How many coils are used in a transformer? Also name them.**

Ans There are two coils which are used in a transformer. Their names are:

1. Primary coil.
2. Secondary coil.

(ii) **For what purpose electron gun is in cathode ray oscilloscope?**

Ans **Electron gun:**

It produces a beam of fast moving electrons called cathode rays. It consists of an electron source which is an electrically heated cathode that ejects electrons. It also has an electrode called grid G for controlling flow of electrons in beam. The number of electrons reaching screen determines brightness of screen light.

(iii) **Give truth table for NOR operation.**

Ans The truth table is:

A	B	$X = \overline{A + B}$
0	0	1
0	1	0
1	0	0
1	1	0

(iv) **Write two advantages of e-mail.**

Ans Two advantages of e-mail are:

1. Versatile:

Pictures or other files can also be sent through e-mail.

2. Fast communication:

We can send messages anywhere in world instantly.

(v) Define telecommunication.

Ans "The method that is used to communicate information to far-off places instantly is called telecommunication."

(vi) What is photo phone?

Ans We can communicate with anyone on photo phone with physical appearance of each other.

Speakers can see each other's pictures. By using photo and phone number of our friends on this telephone, you call them by pressing pad with their photos.

(vii) Define fission reaction.

Ans "A process in which a heavy nucleus breaks into two nearly equal parts with release of energy is called nuclear fission reaction."

(viii) Write the chemical equation for nuclear fusion.

Ans The chemical equation is:

$$^{2}_{1}H + ^{3}_{1}H \longrightarrow ^{4}_{2}He + ^{1}_{0}n + \text{energy}$$

If atom of deuterium is fused with the tritium, a helium nucleus is formed with neutron and release of energy.

Part-II

NOTE: Attempt any Three (3) questions.

5.(a) What is ultrasound? What are its benefits? (4)

Ans "Sounds of frequency higher than 20,000 Hz which are inaudible to normal human ear are called ultrasound."

Uses of ultrasound in medicine:

Some uses of ultrasound in the medicine field are as under:

- In medical field, ultrasonic waves are used to diagnose and treat different ailments. For diagnosis

of different diseases, ultrasonic waves are made to enter the human body through transmitters. These waves are reflected differently by different organs, tissues or tumors, etc. The reflected waves are then amplified to form an image of the internal organs of the body on the screen. Such an image helps in detecting the defects in these organs.

- Powerful ultrasound is now being used to remove blood clots formed in the arteries.
- Ultrasound can also be used to get the pictures of thyroid gland for diagnosis purposes.

Uses of ultrasound in technical field:

1. Ultrasound waves carry more energy and higher frequency than audible sound waves. The wavelength of ultrasound waves is very small and is very useful for detecting very small objects.
2. Ultrasound is used to locate underwater depths or is used for locating objects lying deep on the ocean floor.
3. Ultrasound is also used to see the shape and size of the object.
4. Germs and bacteria in liquids can also be destroyed by using high intensity ultrasound waves.
5. Cracks and flaws in the interior of the moving parts of high speed heavy machines such as turbines, engines of ships and airplanes due to excessive use can be detected by ultrasound waves.

(b) A simple pendulum completes one vibration in two seconds. Calculate its length when g = 10 ms^{-2}. (3)

Ans **Given data:**

$T = 2\ s$

$g = 10\ ms^{-2}$

To find:

$L = ?$

Using the formula:

$$T = 2\pi\sqrt{\frac{L}{g}}$$

Taking square on both sides,

$$T^2 = 4\pi^2 \times \frac{L}{g}$$

$$L = \frac{T^2 \times g}{4\pi^2}$$

By putting values, we get,

$$L = \frac{(2)^2 \times 10}{4\,(3.14)^2}$$

$$= \frac{4 \times 10}{4 \times 9.86}$$

$$= \frac{40}{39.4}$$

$$\boxed{L = 1.02\ m}$$

6.(a) Define simple microscope and also derive the formula of magnifying power. (4)

Ans "A simple microscope is a convex lens which is used to produce magnified images of small objects."

It is also called magnifying glass. The object is placed nearer to the lens than the principal focus that an upright, virtual and magnified image is seen clearly at 25 cm from the normal eye.

Magnifying power:

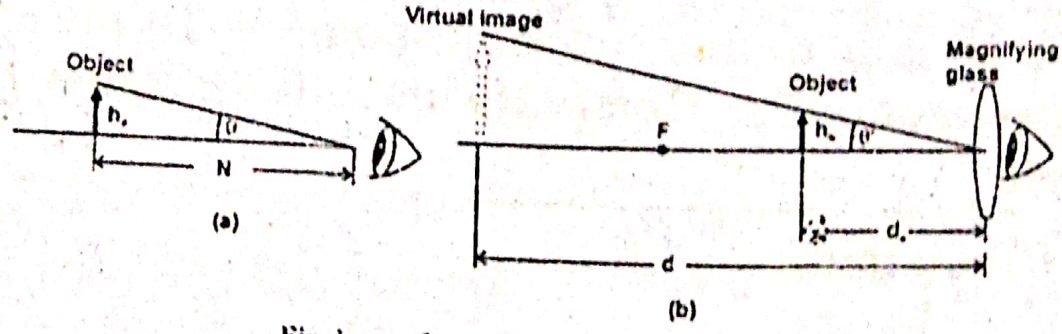


Fig. Image formation in magnifying glass

The magnifying power is the angular size of the final image produced by the magnifying glass divided by an

angular size of the object seen without the magnifying glass.

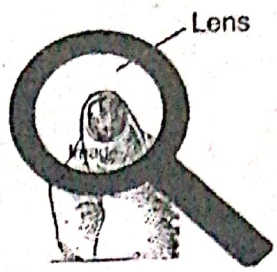


Fig. Image in a magnifying glass.

It is also known as angular magnification, denoted by M.

$$M = \frac{\text{Angular size of final image produced by magnifying glass}}{\text{Angular size of object seen without magnifying glass}}$$

Let θ' is the angular size of the final image produced by the magnifying glass (Fig. a) and θ is the angular size of the image seen without magnifying glass (Fig. b), then magnifying power can be written as:

$$M = \frac{\theta'}{\theta}$$

Fig. b indicates that the lens produces virtual image which is enlarged and upright with respect to the object.

If d_0 is the near distance of the object from eye which is usually equal to 25 cm, then magnifying power becomes as:

$$M \approx \left(\frac{d_0}{f}\right) + 1$$

(b) A convex lens of focal length 6 cm is to be used to form a virtual image three times the size of the object, where must the lens be placed? (3)

Ans Given data:

$f = 6$ cm

$q = -3p$ (For virtual image)

To find:

$p = ?$

Solution:

Using the formula:

$$\frac{1}{f} = \frac{1}{p} + \frac{1}{q}$$

By putting values, we get

$$\frac{1}{6} = \frac{1}{p} - \frac{1}{3p}$$

$$\frac{1}{6} = \frac{3-1}{3p}$$

$$\frac{1}{6} = \frac{2}{3p}$$

$$3p = 12 \text{ cm}$$

$$p = \frac{12 \text{ cm}}{3}$$

$$\boxed{p = 4 \text{ cm}}$$

7.(a) Write down the characteristics of parallel combination of resistors. (4)

Ans Parallel combination of resistors:

In parallel combination of resistors, one end of each resistor is connected with positive terminal of the battery while the other end of each resistor is connected with the negative terminal of the battery. Therefore, the voltage is same across each resistor which is equal to the voltage of the battery. Thus,

$$V = V_1 = V_2 = V_3$$

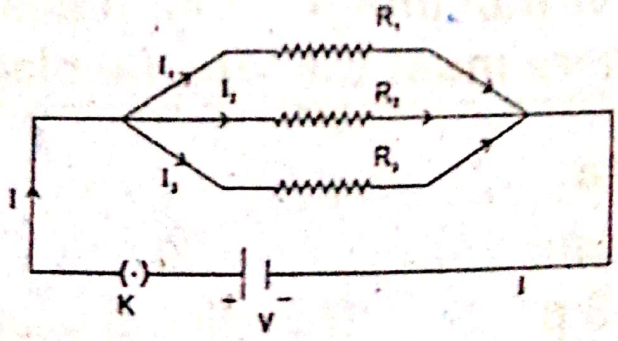


Fig. Three resistors in parallel combination

In parallel circuit, the total current is equal to the sum of the currents in various resistances. Thus,

$$I = I_1 + I_2 + I_3 \quad \ldots(1)$$

Since the voltage across each resistance is V, so by Ohm's law

$$I_1 = \frac{V}{R_1},\ I_2 = \frac{V}{R_2} \text{ and } I_3 = \frac{V}{R_3}$$

Thus eq. 1 can be written as:

$$I = \frac{V}{R_1} + \frac{V}{R_2} + \frac{V}{R_3}$$

or $$I = V\left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}\right) \quad ...(2)$$

If we replace the combination of resistors with a single resistor called the equivalent resistance R_e such that the same current passes through the circuit. From Ohm's law $I = \frac{V}{R_e}$. Thus, eq. (2) becomes

$$\frac{V}{R_e} = V\left(\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}\right)$$

or $$\frac{1}{R_e} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \quad ...(3)$$

Thus, the reciprocal of equivalent resistance of a parallel combination is the sum of the reciprocal of the individual resistances, which is less than the smallest resistance of anyone of the resistor connected in this combination. If resistances R_1, R_2, R_3, ..., R_n are connected in parallel, the equivalent resistance of the combination will be given by:

$$\frac{1}{R_e} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + ... + \frac{1}{R_n}$$

(b) Two bodies are oppositely charged with 500 μC and 100 μC. Find the force between the two charges if the distance between them in air is 0.5 m.

Ans Given data:

$q_1 = 500\ \mu C$

$= 500 \times 10^{-6}\ C$

$q_2 = 100\ \mu C$

$= 100 \times 10^{-6}\ C$

$r = 0.5\ m$

To find:

$F = ?$

Solution:

Using formula:

$$F = \frac{1}{4\pi \epsilon_0} \frac{q_1 q_2}{r^2}$$

$$F = 9 \times 10^9 \times \frac{500 \times 10^{-6} \times 100 \times 10^{-6}}{(0.5)^2}$$

$$\boxed{F = 1800\ N}$$

8.(a) What is cathode ray oscilloscope? Write a brief note on its components. (4)

Ans **Cathode-ray oscilloscope:**

The cathode-ray oscilloscope is an instrument which is used to display the magnitudes of changing electric currents or potentials.

Different parts of CRO:

The different parts of a cathode-ray oscilloscope are:

1. The Electron Gun.
2. The Deflecting Plates.
3. A Fluorescent Screen.

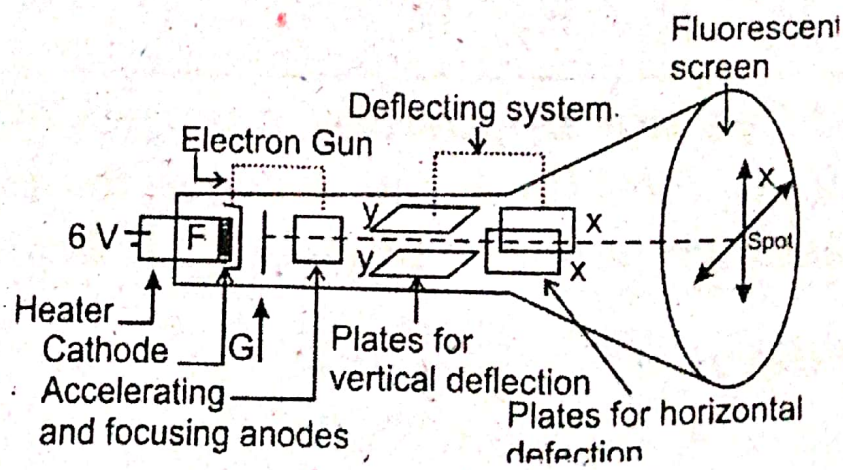


Fig. Cathode-Ray Oscilloscope.

1. The electron gun:

An electron gun produces a beam of fast moving electrons called cathode rays. The electron gun consists of an electron source which is an electrically heated cathode that ejects electrons. Electron gun also has an electrode called grid G for controlling the flow of electrons in the beam. The grid is connected to a negative potential. More negative this potential is, more electrons will be repelled from the grid and hence fewer electrons will reach the anode and the screen. The number of electrons reaching the screen determines the brightness of the screen. Hence the negative potential of the grid can be used as a brightness control. The anode is connected to positive potential and hence it is used to accelerate the electrons. The electrons are focused into a fine beam as they pass through the anode.

2. The deflecting plates:

After leaving the electron gun, the electron beam passes between a pair of horizontal plates. A potential difference applied between these plates deflects the beam in a vertical plane. This pair of plates provides the Y-axis or vertical movement of the spot on the screen. A pair of vertical plates provides the X-axis or horizontal movement of the spot on the screen.

3. The fluorescent screen:

The screen of a cathode-ray tube consists of a thin layer of phosphor, which is a material that gives light as a result of bombardment by fast moving electrons.

(b) A transformer is needed to convert a mains 240 V supply into a 12 V supply. If there are 2000 turns on the primary coil, then find the number of turns on the secondary coil. (3)

Ans **Given data:**

$Vp = 240\ V$

$Vs = 12\ V$

$Np = 2000$

To find:

$Ns = ?$

Solution:

Using formula:

$$\frac{Vs}{Vp} = \frac{Ns}{Np}$$

$$Ns = \frac{Vs}{Vp} \times Vp$$

By putting values, we get

$$Ns = \frac{\cancel{12}^{2}}{\cancel{240}^{4}} \times \cancel{2000}$$

$$\boxed{Ns = 100}$$

9.(a) What are the components of information technology? Write the function of any three. (4)

Ans The components of information technology are:

1. Hardware
2. Software
3. Data
4. Procedure
5. People

1. Hardware:

The term hardware refers to machinery. This includes the central processing unit (CPU) and all of its support equipments, input and output devices, storage devices and communication devices.

2. Software:

The term software means the computer programs and the manuals that support them. Computer programs are machine-readable instructions that direct the circuitry

within the hardware parts of the CBIS to produce useful information from data.

3. Data:

Data are facts and figures that are used by programs to produce useful information. It may be in the form of text, graphic or figure that can be recorded and that have specific meaning.

(b) Carbon-14 has a half-life of 5730 years. How long will it take for the quantity of carbon-14 in a sample to drop to $\frac{1}{8}$ of the initial quantity? (3)

Ans Given data:

$T_{1/2} = 5730$ years

Fraction to be dropped = $\frac{1}{8^{th}}$

To find:

Original quantity No. = ?

t = ?

Solution:

Amount of C-14 after 1st half-life $= \frac{1}{2}$ (No).

// // // 2nd // $= \frac{1}{2}\left[\frac{No}{2}\right] = \frac{No}{4}$

// // // 3rd // $= \frac{1}{2}\left[\frac{No}{4}\right] = \frac{No}{8}$

$= \frac{1}{8}$ (No)

Result:

After 3rd half-life, $\frac{1}{8^{th}}$ part of the initial carbon-14 will be left, so

$t = 3\,T$

$t = 3 \times (5730 \text{ years})$

$t = 17190$ years

$t = 1.72 \times 10^4$ years

Part-III (Practical Part)

Attempt any Two (2) questions.

A(i) If the value of angle of incidence ($\hat{i}$) is 37° and angle of refraction ($\hat{r}$) is 22°, then find the value of refractive index by using Snell's law. (3)

Ans

$\angle\hat{i} = 37°$

$\angle\hat{r} = 22°$

As

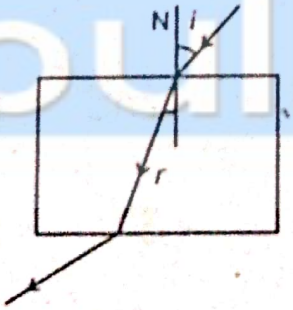
$$n = \frac{\sin i}{\sin r}$$

$$n = \frac{\sin 37°}{\sin 22°}$$

$$n = 1.6$$

(ii) Write down the laws of refraction. (2)

Ans 1. The incident ray, refracted ray and the normal at a point of incidence, all lie in the same plane.

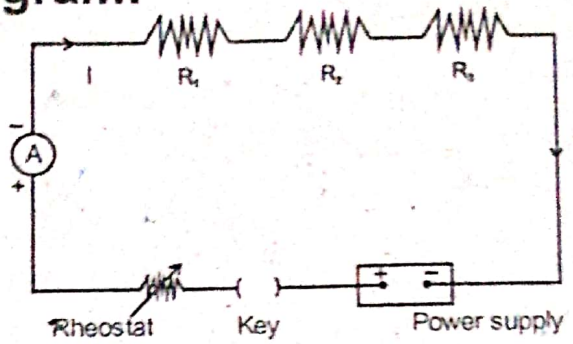


2. The ratio of the sine of the angle of incidence ∠i to the sine of the angle of refraction ∠r always equal to constant.

i.e., $n = \frac{\sin i}{\sin r}$

B(i) If $R_1 = 10\ \Omega$, $R_2 = 15\ \Omega$ and $R_3 = 0.02\ k\ \Omega$, then draw a circuit diagram of series combination and find equivalent resistance. (3)

Ans **Circuit diagram:**



$R_1 = 10\ \Omega$

$R_2 = 15\ \Omega$

$R_3 = 0.02\ k\Omega$

$= 0.02 \times 10^3\ \Omega$

$= 20\ \Omega$

$R_{eq} = R_1 + R_2 + R_3$

$= 10 + 15 + 20$

$R_{eq} = 45\ \Omega$

(ii) Define Ohm's law and also write its mathematical equation. (2)

Ans **Ohm's law:**

"The amount of current 'I' passing through a conductor is directly proportional to the potential difference 'V' applied across its ends, provided the temperature and the physical state of the conductor do not change."

Mathematical form:

Its mathematical form is

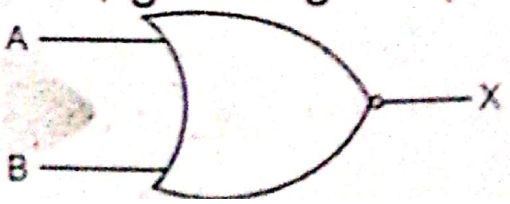
$$V = I R$$

where R = resistance of the conductor.

C Draw symbolic diagram of OR gate. Verify its truth table with the help of Boolean equation. (5)

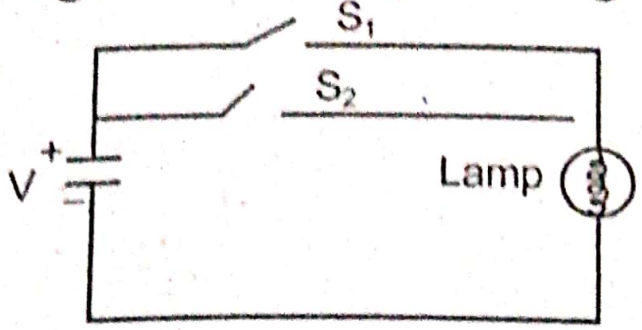
Ans **Symbol:**

The symbol of OR gate is given below:



Circuit diagram:

The circuit diagram of OR gate is given below:



Boolean equation:

The boolean equation of OR gate is given below.

$X = A + B.$

Truth table:

The truth table of OR gate is given below.

A	B	X = A + B
0	0	0
1	0	1
0	1	1
1	1	1

S_1	S_2	$X^{(Lamp)}$
OFF	OFF	OFF
ON	OFF	ON
OFF	ON	ON
ON	ON	ON